GAS IN INDUSTRY

FEBRUARY 1960
Vol. 3 No. 21

FEATURES

THE USE OF GAS IN PAINT MAKING
By Eric Ford

BEVERAGE AND HOT WATER APPLIANCES
By 'GAStronome'

THE IDEAL HEATING MEDIUM FOR 'DIRECT CONTACT' PROCESSES
By I. L. S. Golding

FURNACE PLANT AT THE FACTORIES OF BABCOCK & WILCOX LTD.

Published by
WALTER KING LTD
11, BOLT COURT FLEET STREET
LONDON, E.C.4.

Telephone: FLEet Street 2236-7
Telegrams: Gasking, Fleet, London

Editorial

Simplified industrial gas equipment

SINCE the primary use of gas by industry is for some kinds of heat treatment, the establishment of ways and means of achieving satisfactory results are of great assistance to both industrialist and gas engineer. Such considerations also extend to the creation of special atmospheres.

In the past papers have appeared describing special processes in which gas can assist the industrialist, but we think that Mr. I. L. S. Golding's article on 'Gas—the ideal heating for direct contact processes and similar operations,' which we are publishing this month, gives a particularly good idea of certain types of equipment of interest to the industrialist as well as providing a concise account of their capabilities.

Where the products of combustion may be harmful to the work undergoing treatment, the muffle is often suitable, but its use is confined to small furnaces since the efficiency of heat transfer falls off with increase in size. For larger furnaces an incandescent gas-heated tube is more suitable. The construction of such tubes is important if distortion is to be avoided by unequal heating and leakages caused by wide differences in temperature and the opening of certain joints is to be guarded against.

Mr. Golding describes a design of tube which obviates these possible disadvantages and ensures the highest possible heat transfer. Heating by means of tubes of this type has certain advantages over electricity since more rapid heating of the work is possible and the need to protect the electrical heating elements naturally does not arise.

The production of special atmospheres is quite an easy task for gas to perform since the regulating of the ratio of fuel gas to air for combustion is simply carried out. But here again the conditions must be carefully studied and the decision made as to whether an exothermic or endothermic atmosphere is needed. A type of atmosphere needed in a bright steel annealing furnace where the presence of oxygen would damage the work being treated, is produced by an exothermic plant and Mr. Golding describes a very neat 'packaged' type of appliance in which all the operations, including gas metering, are contained in a single unit. Where sulphur or moisture need to be extracted, the necessary plant may be included in the single packaged appliance.

Certain heat treatments require an absence of carbon dioxide. The plant required is somewhat more complicated and a means for its extraction must be included. Mr. Golding instances a plant employing monoethanolamine as an absorbant, a reagent which is reversible in its action and can be revivified by boiling. Atmospheres containing hydrogen and nitrogen only can be made by converting the carbon monoxide present to the dioxide by the shift reaction and its absorption in monoethanolamine. Pure nitrogen is also possible.

Endothermic atmosphere plants may also be made in the neat packaged form, but since the ratio of air to gas used is so far below that for complete combustion, external heat must be applied. Atmospheres completely free of carbon dioxide may be made in this way and Mr. Golding forecasts a very much cheaper means of obtaining an atmosphere similar to cracked ammonia in a plant of this type.

Gas chosen as the ideal fuel by famous firm of paint makers

By ERIC FORD

WHILE it is true that paint manufacture is a very ancient craft, it is equally true to claim that never before has the industry been able to offer the domestic or industrial user such a variety of paints, varnishes and other coatings which are more attractive in appearance, easier to apply and more effective against the ravages of corrosion than any of the products of former years.

These claims can be confidently advanced on behalf of the many products of the old-established firm of Sherwoods Paints Ltd., of Barking, Essex, where gas plays an important part in the varnish manufacturing process, the first stage of paint production. In 1958, the company consumed more than 7 mill. cu.ft. of gas from the North Thames Gas Board.

In the manufacture of paint, it is first necessary to produce a basic 'vehicle,' into which suitable pigments and other ingredients can later be ground to yield a product of the desired type and colour. The basic vehicle, commonly known as a varnish medium, normally consists of one or other of two main types, namely, the alkyd resin, or synthetic type and those based on natural gums. A large proportion of the paint manufactured in Britain today, and certainly at the Sherwoods factory, is based on the synthetic resin vehicle.

To produce either of these varnish media, heat treatment plays an important part in the operation and it is in this first stage, prior to the paint manufacturing process, that the greater part of the gas consumed by Sherwoods Paints Ltd., is used. Gas is particularly suitable in these applications for several reasons. Ease of control at the high temperatures required, where over-heating can have deleterious effects upon the quality of the product; the fact that it can be readily applied at the point desired and that it is also a quick form of attaining the amount of heat required are but a few.

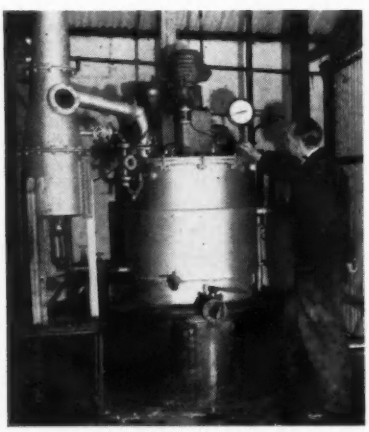


Fig. 1. With this equipment, small, specialised batches of material are prepared. On the left is the catchpot, where water is removed for measurement—an important means of determining the process stage.

An illustration of the way in which Sherwoods Paints Ltd. produce a paint vehicle is provided by the 120-gal. experimental plant in which small, specialised batches of material are prepared. This equipment, used mainly for the production of synthetic resins, measures 2 ft. 6 in. in diameter and is 3 ft. high. The pot has a water-cooled jacket, and is fitted with motorised stirring gear. The furnace setting is 4 ft. 6 in. diameter and 2 ft. high. It is fired by one air blast burner with a British Furnaces proportioner and inspirator. The gas rate is 600 cu.ft. per hour.

Appropriate quantities of the ingredients required by the particular 'recipe' concerned are charged into the plant and heat applied to the materials being processed at temperatures in the region of 500°F. The ingredients include a solvent which aids the drawing off of water content as vapour. These condense into a catch-pot, the water being drawn off for measurement and the major part of the solvent returning back into the plant, thence to repeat the re-circulation procedure.

In this process, the water which comes off as vapour helps to determine the point at which the material has completed its process. When the required amount of water has been drawn off, as determined by the recipe, the material can be removed from the plant for, after thinning, storage and testing in readiness for the

next stage—the paint process. The time required for the completion of the heating cycle naturally varies with the job and may range between 12 and 24 hours.

Time and temperature recording is effected in this case by an Elliott Brothers (London) Ltd. instrument which automatically graph-records the complete heating and cooling cycle of each batch, as well as the time taken to process it.

A continual check on the progress of the material under process in the plant is maintained in the varnishes laboratory, where samples drawn at regular intervals are subjected to various tests until the batch has reached its 'cooking end' point. It is at this stage that it is cooled down by circulating cold water through the jacket round the pot and 'thinned out' afterwards by various solvents.

One of the various tests which are carried out in the laboratory on the batch being processed includes a viscosity test, in which ball-bearings of pre-determined weight and size fall through a measured quantity of the material in a test tube which is in turn inserted in a glass container wherein a set temperature is maintained. When the ball-bearings take the required time to fall to the bottom of the test-tube, measured by a stop-watch, the batch is considered to have reached its 'cooking end' point and the plant is shut down (gas burners off and water cooling equipment set in motion).

Varnish plant

A considerably larger plant is used for producing varnish as media for paint and other products, employing a basically similar process. This is a plant manufactured by R. W. Winter & Co. Ltd., and is fitted with two air blast burners firing into immersion tubes with British Furnaces proportioners. There are also two supplementary burners which fire under the base of the pot. These burners are also fitted with British Furnaces proportioners. The pot itself is 48 in. in diameter and is water-cooled, while mechanical agitation of the contents is provided with paddle-type stirrer.

This plant is about 12 ft. in height; its upper half is reached by a stairway up to a platform. The controls, of the push-button variety, are sited at ground level. The combined temperature controller and recorder is supplied by Honeywell Brown. This controls the air blast burners by means of motorised valves on the air line. A Delta air flow switch is fitted on the air line as a fan failure device. This is connected to a Perl 60 magnetic relay valve on the gas supply to each burner.

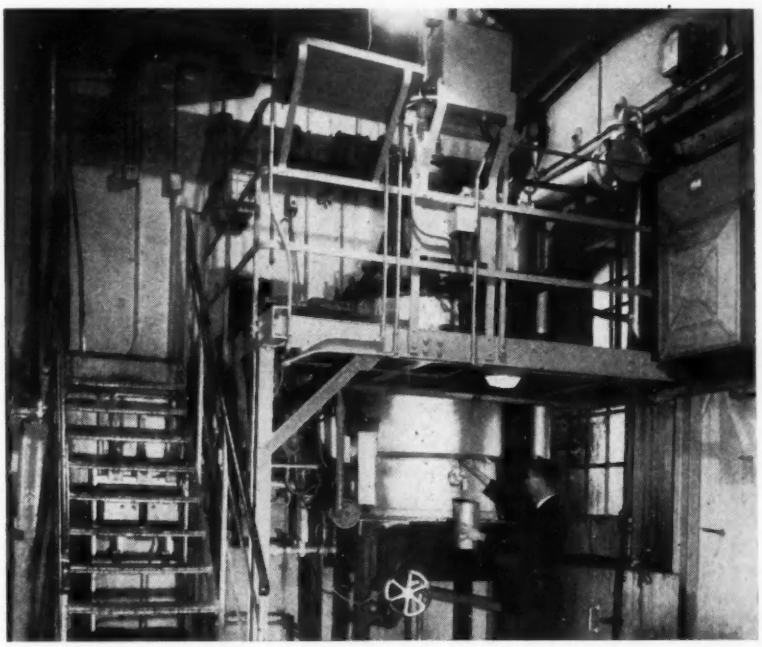


Fig. 2. This plant is used for producing varnish. The gas rate is 1,500 cu.ft. per hr.

Overheat control is fitted as an independent unit which operates a warning bell if the temperature required is exceeded. Solenoid valves are fitted on the pilot supplies, wired in conjunction with Protectoglo flame failure equipment. The temperature control gear is connected to a pyrometer stem immersed in the pot.

This equipment has a gas rate of 1,500 cu.ft. per hour, and a fume extracting condenser is also fitted as part of the equipment.

One of the most interesting pieces of gas-fired equipment at Sherwoods Paints Ltd. is a Sommer Schmidding Universal synthetic resin plant. This also operates on the same general principle as the other equipment, but the utilisation of heat is in a different form. The product, after treatment, can be pumped direct through pipelines to the storage tanks.

This plant has been set up in a well-lit section of the works and is laid out with every attention to ease of operation and control. A railed platform is fitted with broad steps to enable the main vessel to be charged with the ingredients. The main vessel and most of the ancillary equipment was designed and constructed by the German firm of Heinrick C. Sommer, of Dusseldorf. The installation of the equipment was carried out in conjunction with the industrial section of the North Thames Gas Board.

Mounted at floor level in a refractory setting constructed by the M.E.T. Furnace Co. Ltd., Trafalgar Road, Greenwich, the main vessel is of stainless steel. Three specially designed air/gas proportioning valves are connected to 3-in. gas and air lines and serve air blast burners of German design. The burners fire beneath diffusing plates, which prevent direct flame impinging on the base of the vessel. The three burners have a combined maximum consumption rate of 2,400 cu.ft. per hour.

Ingredients are charged into the vessel from the top, thoroughly mixed during heating by an agitator fixed to a vertical spindle driven by an electric motor fixed to the top of the vessel and capable of operation at either 33 or 67 revolutions of the vertical spindle per minute. A foam breaker operates from the same spindle.

In operation, this equipment is basically similar to the other units already described. In this case, a large water-cooled condenser is fitted on the right of the plant, condensing the water and solvent which are given off, under heat, in the form of vapour. There are twin solvent catchpots, also on the right of the equipment.

A control panel is sited well clear of the plant, but in a position where a clear view of the equipment is obtained. This includes a graph recorder complete with alarm bell system. A mercury-in-steel thermo-

meter and recorder is immersed inside the vessel to indicate temperature.

Burner controls, however, are sited in a pit outside the building housing the main plant, (apart from the main shut-down valve). Three feeder pipes supplying the burners are fitted with specially designed proportioning air/gas cocks. Fitted to these is a 4-in. gas supply and 3-in. air supply. The gas manifold is connected to a combined governor and cut-off valve, which opens when the air supply is on.

This pit also contains the air blowing fan and twin flues from the refractory setting by which products leaving the combustion chambers discharge to atmosphere through 9-in. asbestos flues 15 ft. high. The motor-driven blower, capable of delivering 175 cu.ft. per minute of air at 22 in. w.g. when running at 2,890 r.p.m., is sited adjacent to the burner controls, which are manually operated.

Gas consumption is independently recorded by a No. 1 Rotary meter fitted direct into the gas line adjacent to the furnace.

Finished medium can be piped away from the plant through an outlet pipeline 2 in. in diameter which is fitted on the top of the vessel. There is a cut-out switch so that when the pipeline is lowered into the pumping position, the stirring gear cannot be started.

For the complete draining of the plant, a small diameter flex line is coupled to the vacuum pump.

Varnish from the plant is first pumped to an enclosed thinning well which is fitted with a water-cooled condenser to prevent solvent loss. When required, the varnish is then pumped through pipe-lines direct to the storage buildings where many thousands of gallons of media—the basic constituent of paints of all kinds—are stored. Varnish from the other installations is also pumped to this storage area; an impressive sight, with the large rectangular tanks standing in rows.

From here, varnish of the kind required for the different paint recipes, of which, incidentally, there are many hundreds, can be pumped via overhead pipe-lines to other parts of the 14-acre site where a series of complex operations changes the varnish into one of the many colours and qualities of paint produced by Sherwoods Paints Ltd.

Essentially, however, the basic operation is a grinding process, carried out in either a ball mill or on a roller mill, in the course of which the pigments and so forth are added to the media.

After passing through the machines, the paint-base is run into mixing tanks or small mobile mixing units to be thinned and tinted. It is interesting to note that so careful is the firm to make sure that tinting results in the correct shade that this process stops when natural light fails, and no tinting is permitted by artificial light.

When a particular batch of paint is completed it is then subjected to rigorous scientific tests in the paint laboratory where such factors as colour, viscosity, drying time and the like are carefully examined by appropriate tests.

Only when these tests have been successfully passed is the paint allowed to be filled into the tins or containers for despatch to wholesalers, special customers or any of the many company depots all over the United Kingdom.

'Gum-running'

From start to finish, the paint has been subjected to up-to-date processes, a far cry from the methods used when the firm commenced manufacturing this commodity in 1777. Curiously enough, however, there is one part of the works where an older method of preparing varnish, known as 'gum-running,' is still occasionally used. The equipment used in this process and others includes seven gas-fired pit furnaces.

This method of heating the gum is carried out in small pots and is particularly employed for certain special orders which cannot be economically made on machinery primarily designed for bulk production.

In this method, the ingredients are charged into pots fitted with trunnions and set over gas-fired furnaces below ground level. British Furnaces air blast burners and proportioners are fitted to each furnace setting, with fume extraction by movable trunking to allow the pots to be removed as required by the process. The gas consumption rate is about 500 cu.ft. per hour, through the 12-in. diameter air blast pan burner.

Operator's skill

After charging, the contents of the pot are brought up to the required temperature and held until it is judged that the charge has been sufficiently treated, after which other additions are made. Certain recognised tests are made during this heating period so the pot requires continual watching.

Although the full resources of the varnishes laboratory are available to provide a check on the quality of the product, it is interesting to note that in this department of varnish manufacture the accumulated skill of the operator is still as vital today as when gum-running was the most common method of producing varnish for paints, and many other uses.

When it is considered that the con-

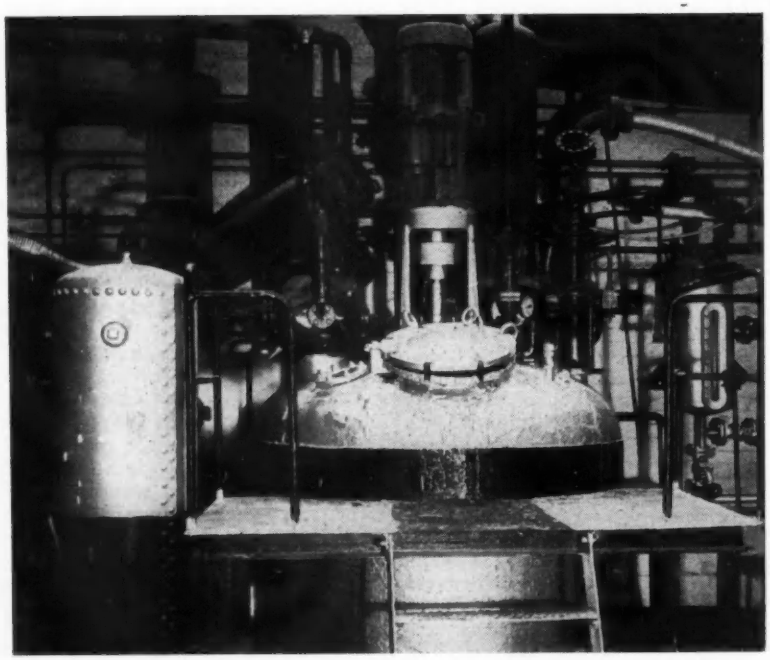


Fig. 3. A general view of the Sommer Schmidding Universal synthetic resin plant.

Fig. 4. A battery of rolling mills, used in the grinding of ingredients. The chutes bring the ingredients from the upper floor. As can be seen, this section is extremely well-lit, by natural and artificial means.

tents of the pot have received sufficient heat, the pot is removed from the pit furnace by an ingenious wheeled arrangement and taken outside for cooling and thinning.

Technical services

In addition to laboratories for the continuous testing of varnish and paint, Sherwoods Paints Ltd. also maintain a well-equipped technical service department at the disposal of actual (and potential) customers seeking the solution to problems concerning paint which they meet in the course of their operations. Such problems may concern the application of paints to particular surfaces or the stoving times for paints in certain applications. The equipment maintained in this department includes several items of gas-fired plant of the laboratory type.

Special testing

This equipment includes two treble-cased stoving ovens, one 6 ft. by 6 ft. by 6 ft. and the other 3 ft. by 2 ft. 6 in. by 2 ft. 6 in., a 3 ft. infra-red tunnel and a small oven for special testing purposes.

Stoving problems are clearly of considerable importance to any paint manufacturer which, like Sherwoods Paints Ltd., produces stoving enamels for its customers. It is thus necessary to have plant which can reproduce the conditions experienced by customers. In this way, the firm can test the enamels it produces in order that the correct specification is passed to its customers. Subsequently, tests can be carried out under controlled laboratory conditions on samples of any enamels with which customers have experienced stoving difficulties.

Heat control

For either of these purposes, the treble-cased ovens or the infra-red oven can be used as required. The larger of the two treble-cased ovens is fired by jets below the casing and the heat is controlled by a damper at the rear. Temperature recorders give readings for the top, centre and bottom of the oven.

Equipment in this laboratory is also used in the regular programme of development work which the company is continually pursuing, including work on a polyester synthetic resin finish for furniture and other trades, where French polish or cellulose coatings are otherwise commonly used.

Continued improvement

Although the company is within sight of reaching its 200th birthday, it is clearly moving with the times in applying scientific methods to the continued improvement of the performance of its existing range of products and the development of new paints and coatings. It is gratifying to note that gas is playing an important part in furthering this process.

Gas is supplied by the North Thames Gas Board from its Beckton gasworks, situated only a few hundred yards from Sherwoods factory. The gas supply is through one 9,000 cu.ft., one 1,800 cu.ft., and one 700 cu.ft. meter.

Beckton supply

Although the major proportion of the gas consumed by Sherwoods Paints Ltd. is employed in one or other of the processes of varnish manufacture, the firm's well-appointed canteen is fitted with gas-fired cooking equipment and some gas is used for heating purposes.

All this gas is received direct from the producing station at nearby Beckton; this closeness to the supply source is paralleled by the close co-operation which exists, both in respect of the supply of gas and the service which accompanies it, between the industrial officers of the Board and the firm of Sherwoods Paints Ltd., whose products are widely used in domestic and industrial applications at home and overseas.

KNOW YOUR KITCHEN EQUIPMENT

5.—Boiling water and beverage making appliances

By 'GAStronome'

THIS, the last section of the series, deals with tea and coffee making equipment, which prompts me to consider that this important part of industrial catering is usually relegated to the end and thought of as an accepted operation that can be the care of one of the more responsible kitchen hands. What a failing in catering welfare that is, but it is so very often true, and, of course, the results are in keeping with the approach; tea and coffee that can only be described as poor in brew, and service that only worsens it.

Tea or coffee making is a very simple task and it can be a very economical one as well. So before describing the equipment that is available, it is of interest, indeed it is *essential*, to know something about making these two pleasant and stimulating beverages, and the costs likely to be incurred in producing them for the staffs.

Categories of boiling

The methods used to boil water can and do vary, but they usually fall within the categories that use these appliances—low pressure boilers, expansion, overflow boilers, and bulk water boilers. All three can be complementary to any of the methods of tea making used in large scale work. These are summarised as: Individual teapots, teapots for up to four people, cafeteria teapots, 'multipots' or insulated serving urns, and self service of boiling water for individual tea making.

There are also combination boiling water and tea making appliances using any of the three methods of boiling.

Cafeteria teapot service.

This method has much to commend it, as the tea is always freshly made. Service may be at the counter to the customers or by waiter service during the meal itself. This latter method is adopted by J. Lyons & Co., being an excellent compromise between individual teapot service and self service. Such teapots usually hold six pints, but eight pint teapots are used, and the boiling water requirements depend upon the speed of service. The number of tea cups to the gallon of tea can be taken as 20 cups = one gal.

As an example, if the maximum demand is for 10 cups per minute, then one teapot will suffice for a minute and a half spell, and assuming that an infusion time of four to five minutes is required, then four teapots are required. The demand is estimated at 18 pints per five minutes and a boiling water machine of 240 pints per hour is required. A bulk boiler is not desirable for the application, as demand may be intermittent.

Tea in industry.

The service of tea in industry is a separate problem from that affecting ordinary cafeteria, mainly for the reason that, apart from the main meal of the day, which will be spread over as much as two hours, two tea breaks occur during the day, breaks which generally last for ten minutes. In many cases the whole factory or plant stops operation. Such tea breaks, if prolonged, have an adverse effect on production and should never be allowed; the need of a well-organised tea service is apparent and can be arranged.

There are several methods of serving tea, but two are paramount. They are the static and the mobile methods.

Static tea service.

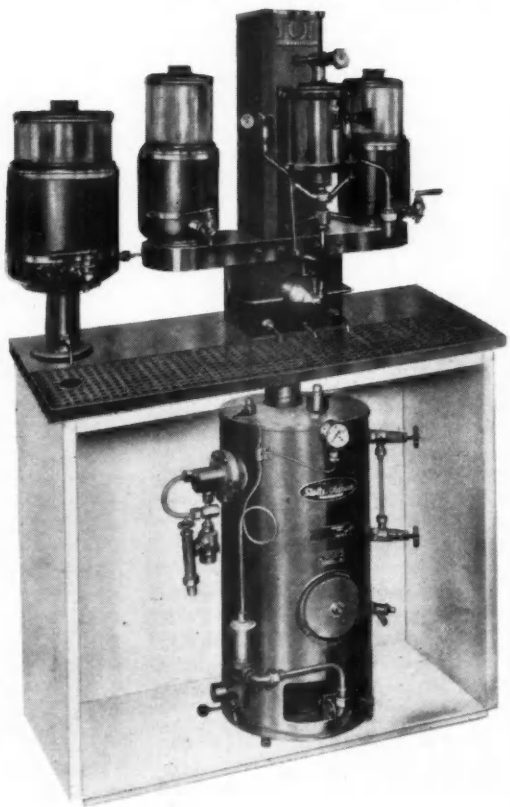
Static service means that all the workers go to the tea making unit, which in some cases will be the main canteen, or it may be a separate tea bar or a series of tea bars situated one on each floor, or in each section. The disadvantage of this system is that there is a waste of time in the movement of personnel to the tea bar and the queueing and delay that may occur.

Static service should be so organised that all tea can be served before one-third of the time for the tea break has expired, giving the last person served ample time to drink the tea and return to the place of work.

Several rules apply to static tea service:—

1. All tea should be made as late as possible, but in sufficient time to be ready for immediate service at commencement of the break.

2. The cups should be handled by the consumer and not by the



The complete set of the Connoisseur boiler, made by Stotts of Oldham. Featured are the undercounter boiler and, above the counter, the draw-off urns.

server, whose duty it is to fill them.

3. All cups should be milked beforehand. Those who prefer tea without milk can use empty cups that should be available. It is quite permissible to milk the tea in the pot in this case, as the leaves are removed and storage time is short. A separate pot of unmilked tea should be made for those preferring it.

4. Sugar should be available remote from the service point or, alternatively, should be placed in the tea as a dilution with water.

5. Ample space should be available so that the movement of people at the service point is not obstructed.

6. Snacks should be at a separate point away from the tea service.

Apart from these rules, the actual pouring out of the tea can be done in several ways. Insulated urns or multipots with tap may pour into the cup—such a tap can be automatically pushed on by the cup pressure when applied, to allow the server to handle two cups, one filling and one ready for filling, in order to speed the service.

The tea can be poured from the multipot into a six-pint teapot with large pouring spout or a two spout pot for filling two cups at one operation. These pots can have the milk added as the time factor is almost immediate—and deterioration is negligible.

Better proposition

Some multipots incorporate a milk container attached to the outside with a needle valve controlling the measure of milk in relation to the measure of infused tea. They have the disadvantage of being slow in pouring and need meticulous care in cleaning. Milk containers with plastic flexible hose to squirt a measure of milk into the cups appear to be a far better proposition.

Mobile service.

Mobile service can be with multipots conveyed by hand or by trolley; tea is taken to various points and served to groups of workers where a break is given or by individual service from the multipot to the worker where a break is not at one and the same time. It is advisable when sending multipots on a mobile service to be certain that the serving of tea is restricted to 30 minutes; after that time the brew will rapidly deteriorate with the affect of air on the liquid.

This is overcome by using multipots of a size that will be emptied within that period. As an example, if five gal. is the amount to be distributed, but service covers one hour, a two-gal. and a three-gal. multipot would satisfactorily cover this service by using the three-gal. size first. A five-gal. multipot would give a poor cup towards the end of its journey.

A strong brew can also be sent in small capacity multipots for dilution with water boiled at the service points. This strong brew method is satisfactory and has for many years been used in the popular 'Italian' class of café in this country.

Large-scale water boiling equipment. Low pressure boilers.

This type is normally installed underneath the service tea bar counter, but can be designed for counter top work. 'Pressure' boilers depend upon raising the temperature of the water inside the boiler to create steam to a pressure of from 3 to 7½ lb., according to design, such pressure being used to send the water below it to the draw-off tap when operated.

Much to commend

As water can only be drawn off when there is steam pressure, it is definitely at boiling temperature. Boilers that use this principle are the 'Sumerling,' 'Bunhill' and 'Fountain' class; Stills 'canteen' boilers; Stotts 'Connoisseur' boiler; Minimax 'Counter' and 'Under-counter' boiler; and Jackson 'Café-supreme' boiler.

Pressure boilers have much to commend them. They will only produce boiling water; they will always give their rated output provided that the head of water specified in relation to the output is maintained, and that they are serviced regularly. A quantity of bulk water can be extracted in a short period, usually at the rate of 1¼ gal. per minute, an asset in filling multipot urns. Most boilers can be installed below counter, giving a free area above around the draw-off column, a useful asset in the service of tea.

Pressure boilers may be fitted with a steam injector for the rapid heating of teapots and other pre-heating jobs. Pressure boilers are, therefore, accommodating for an hourly intermittent demand and also for limited bulk quantities in short periods, but most of them are not constant flowing over the hourly period. This point is not always a disadvantage as pressure is usually re-established in sufficient time for a normal tea trade relative to the hourly output of the boiler. An exception is the 'Connoisseur' boiler which is a constant flow producing boiler and for that reason its bulk output at short intervals is not so pronounced, the delivery being at the rate of .75 gal. per minute. Against that it has a constant flow output of 34 gal. per hour, adequate for small amounts of bulk tea making.

Also within the 'pressure' group is the Sumerling 'Finsbury' boiler. The method of discharging boiling water is similar, except that it depends upon the turning off of the cold water supply to the boiler to extract, under pressure, the whole of the boiling contents, and as such the boiler is used as a bulk water boiler. This, as far as is known, is the only automatic bulk water boiler available to the market.

Expansion overflow boilers.

These machines adopt the method of heating the water in restricted water ways to boil rapidly and deliver the water at a constant rated output. They have the merit of being brought to working temperature in a short time, usually about four to six minutes, and deliver at rates varying from two to ten pints per minute, acording to size and design. The principle of boiling is by expansion of the water at boiling point rising into a delivery compartment fitted immediately above the water level of the cold water feed tank; from this compartment the water flows to the draw-off control. Care should be taken in fitting the cold water feed tank when this is divorced from the appliance, as in the case of the fountain type expansion boiler, as the water level can allow under-boiled water to be drawn off if the level is above the base of the delivery box, and for a delay in delivery, if fitted below the level.

They are usually automatic in gas and water control action, one of the simplest forms being the interlocking of the main gas control to the burner with the draw-off tap.

Adequate amounts

Expansion overflow boilers are used for the automatic and constant delivery of boiling water adequate for teapot trade, either by table counter service, in amounts up to four pints per minute, or, above that rated output, they can be used for bulk tea making as well.

Bulk water boilers.

In this group can be found practically every kind of open appliance that boils water. The method is, as the name implies, the heating of a bulk of water to boiling point. Equipment that comes under this heading includes kettles, canteen dixies, stew pans, boiling pans, urns, 'farm' boilers and buckets. All are used in some way or

other with the boiling of water for tea making.

The accepted appliance that uses gas for heating and so can be described as a bulk water boiler, is the urn fitted with water inlet, overflow and draw-off points, water level gauge and thermometer. Heat transfer is often obtained by conducting the flue ways through the bulk of water. The capacity range is normally between three and 40 gal.

These three groups are the recognised appliances used in large-scale water boiling. In addition there are on the market some tea making sets. The different processes under which they operate are:—

1. A continuous flow expansion boiler with tea making and storage facilities built-in to the appliance. An example of an appliance using this method is the Jackson 'Teatomaton,' which is a conventional expansion boiler with two, five or ten gallon containers into which the water is allowed to flow when boiling via a removable tea infusing container. The process is operated by hand controls and one container can be used for tea service while infusion takes place in the other container. The containers are kept heated from the boiler and as the infused tea is removed after infusion, storage over a reasonable period can be effected.

2. By means of infusion of tea under pressure passing through a filter into a heated side container which is thermostatically controlled to keep the tea at the right temperature for serving.

An example of this is the Still's tea brewer, where the standard 16 in. or 18 in. boiler is used to boil the water. The brewer consists of a container holding four or six gal. complete with silver-plated metal strainers, the tea being brewed in the container under pressure, this taking approximately six minutes. By a movement of a control lever tea is transferred, again under pressure, to the steam-heated Pyrex glass-lined storage urn, where it may be retained at service temperature for several hours. The transference takes a further six minutes, the process in all taking a little over twelve minutes giving a maximum hourly output of 16 gal. to 24 gal. if required.

3. A central boiler (pressure, expansion or bulk) having side containers heated from the boiler into which the tea is infused. The infuser is withdrawn and the tea can be stored ready for immediate service.

The golden rule with all these tea making sets is to keep the infused leaf clear of the brewed tea and to keep the temperature of the contents at 180°F. or thereabouts. The sealing of the infused tea from the air will considerably improve the flavour and appearance of the tea.

Bulk coffee making.

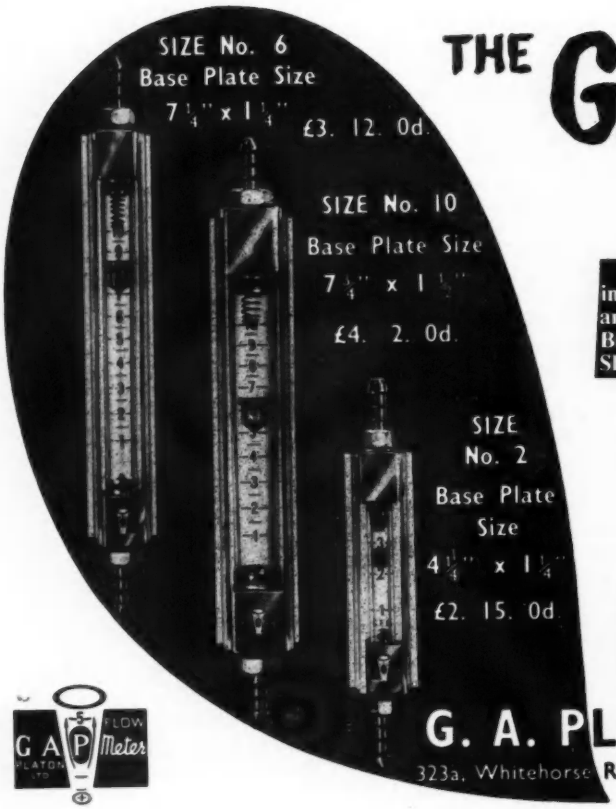
Both pressure and overflow boilers can be fitted with coffee making equipment and coffee and milk storage urns; in many cases these are integral.

Earthenware and heat proof glass-lined urns are available for this purpose as well, and can be used in association with two- or three-burner hotplates, such as the Main 72 rangeplate.

The rules in coffee making are simple: A good blend of coffee, water just below boiling point, and sufficient coffee per gal. of water. This must vary according to requirements, but can be taken as eight to ten ounces per gal. of water.

There is such a wealth of equipment available, that a close study on the lines suggested will amply repay the industrialist.

There is no reason why the basic cost of a cup of tea should exceed 1d. or a cup of coffee 2d. Overheads on top of this will, of course, vary according to local requirements.



THE GAPMETERS

These are variable-area direct-reading flowmeters for liquids and gases. They are simple instruments: accurate, compact and inexpensive.

Gapmeters are adaptable and easy to install in either vertical or horizontal piping (at any angle). Interchangeable fittings allow Front or Back Panel pipe connections; also attachment to Slotted Angle Frames and Laboratory Scaffolding.

Gapmeters, made for ⅛", ¼" and ⅜" B.S.P. sizes (with Nozzle, Straight Union or Banjo fittings), fulfill the need for small, precision-made, flowmeters at low cost for use with Service Fluids, Fuels and Scavenging Fluids, Inert Gases and Cooling Fluids as well as general chemical and process operations.

Floats and other contact components are readily made in materials to suit all industrial fluids. All floats rotate. Bold scales are used, and each instrument is protected by a perspex cover.

G. A. PLATON LTD. *Makers of the Flostat*

323a, Whitehorse Road, Croydon, Surrey. THOrnton Heath 1631

GAS—THE IDEAL HEATING FOR 'DIRECT CONTACT' PROCESSES AND SIMILAR OPERATIONS

By *I. L. S. Golding*

RECENT years have seen rapid increases in industrial capacity which has meant greater demands for heat in processing. Gas with its infinite flexibility of control and relatively low cost has much to offer in a number of these processes. For example, in gas carburising, it is difficult to get adequate heating rates except by use of a gaseous fuel. In this process it is also essential to produce an active atmosphere for which gas may conveniently be used.

In processes where direct contact between products of combustion and work may be tolerated, or slightly reducing conditions are preferred, *i.e.*, in some annealing operations gas offers an ideal heating medium. Even on the simplest natural draught furnaces adjustment of air slide and damper produce an infinite variety of conditions.

Where products of combustion could harm work, and direct contact must be avoided, the use of a muffle is normally employed. On small furnaces the muffle may be used as a work chamber, a practice which has been used for many years. However, on larger furnaces this system is both inefficient and costly, as heat transfer between products of combustion and the work becomes more difficult as the size increases.

To overcome this difficulty, leading furnace manufacturers in this country and in the U.S.A. have developed various forms of radiant tubes where the combustion process takes place within a heat resisting tube which itself then radiates thermal energy to its surroundings. By careful design it is possible to obtain a very high heat output from tubes of given sectional area, the principal limiting factor being heat transfer through the metal, or ceramic used in fabrication. Temperature lead is, of course, important and many tubes sacrifice efficiency for this reason.

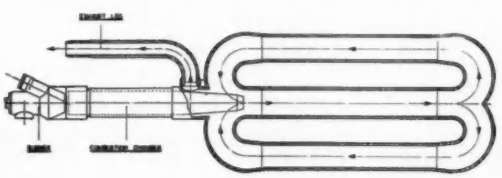
Temperature differences

Frequently these tubes are of the 'straight through' variety consisting only of a burner set in one end of a straight heat resisting tube. These possess the property of being quickly replaced, should a leak or other defect develop. However, it is often difficult to seal a tube at both ends when the centre is subject to enormous variations in temperature. For this reason 'U' or 'horseshoe' type tubes were introduced. Sealing, while necessary at both ends of the tube leaves considerable room for expansion. Here again the tubes have no regenerative system and consists only of a burner firing into one end with products of combustion leaving at the other.

Examination of such tubes when in use shows that great temperature differences can—usually do—occur over the effective heating length of the tube. A development introduced a few years ago by the Incandescent Heat Co. Ltd., uses a recirculating system (shown in Figs. 1 and 2). In this gas is burnt in a refractory lined combustion chamber and the hot high velocity emergent gases entrain partially cooled products which have already imparted their heat to the tube. In this way, even and high efficiency heating is obtained. The spent gases are exhausted continuously through an annular space surrounding the burner tubes. This system also possesses the advantage that only one seal is necessary to prevent ingress of air or escape of atmosphere to or from the furnace work chamber.

Gas fired radiant tubes are widely used in all types of furnaces, many of which exhibit much faster recovery times than are possible with electric heating. In fact, where actively carburising atmospheres are used, these tubes possess a great advantage over electrical elements which have to be either encased, or be in a special form for use with low voltage to prevent short circuiting between loops.

Just as it is important to prevent products of combustion from impinging on work, it is equally desirable to prevent ingress of air and consequent oxidation in many processes. To ensure that the work is not affected by excess oxygen or water vapour, as for instance in bright annealing, an atmosphere is specially prepared by burning a fuel gas with an exact quantity of cut. Frequently water vapour and sulphur compounds must be removed as these would seriously affect the quality of work being processed. A typical plant is shown in Fig. 3. These plants have a basic generator consisting of the necessary metering and boosting equipment for gas and air, burner, combustion chamber, and cooler, together with desulphurising boxes and desiccant-filled gas dryers if required. Normally both these additions would be incorporated if the plants were producing an atmosphere for annealing steel, or, with the exception of the dryer, in the case

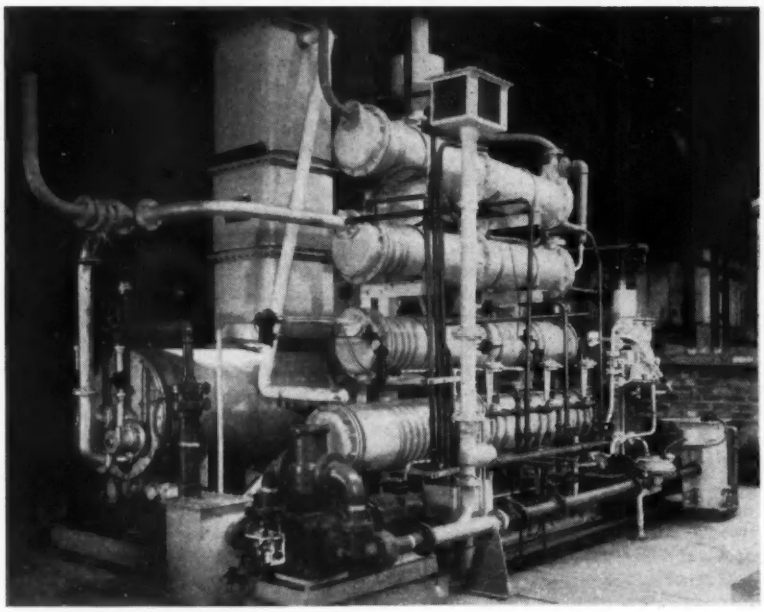


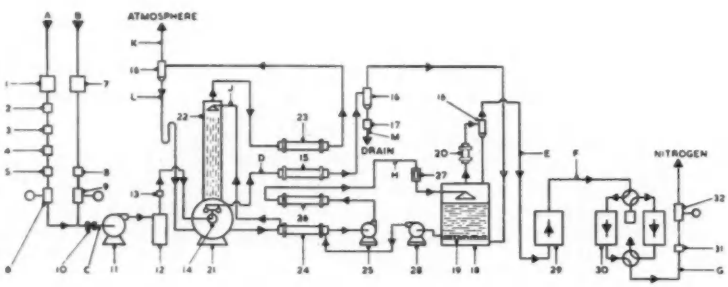
Figs. 1 and 2. A typical radiant tube, with schematic diagram below.

Photos by courtesy of the Incandescent Heat Co. Ltd.

of copper. Atmospheres produced with an evolution of heat are termed 'exothermic.' The composition of an exothermic gas may, of course, vary widely according to the initial air to fuel gas ratio.

It is most important to ensure that some reducing gases (i.e., CO and H_2) are available when slightly oxidised steel is processed and in consequence a rich gas/air mixture is used (1:2½). With copper, however, the presence of hydrogen may cause embrittlement and is therefore best kept to a minimum. This is done by using a near stoichiometric gas to air ratio. Where dryers are used it is often convenient and economical to utilise the heat of combustion for reactivating the spent bed of desiccant.





Figs. 4 and 5. A typical nitrogen plant, with flow diagram below.

Key

EQUIPMENT

1. Gas Filter
2. Gas Pressure Switch
3. Gas Solenoid Valve
4. Zero Governor
5. Gas Limiting Orifice Valve
6. Gas Flowmeter
7. Air Filter
8. Air Limiting Orifice Valve
9. Air Flowmeter
10. Non-return Valve
11. Air-Gas Booster
12. Oil Trap
13. Flame Trap
14. Burner
15. Gas Cooler
16. Gas Liquid Separator
17. Steam Trap
18. Carbon Dioxide Absorber
19. Porous Plates
20. Gas Aftercooler
21. Reboiler
22. Stripper Tower
23. Condenser
24. Amine Heat Exchanger
25. Lean Amine Pump
26. Lean Amine Cooler
27. Lean Amine Flow Indicator
28. Rich Amine Pump
29. Refrigerant Dryer
30. Activated Alumina Dryer
31. Nitrogen Pressure Governor
32. Nitrogen Flowmeter

MATERIAL FLOW

A. Raw Gas
B. Air
C. Air-Gas Mixture
D. Burned Gas
E. Nitrogen Dewpoint $< 100°$ F.
F. Nitrogen Dewpoint $+40°$ F.
G. Nitrogen Dewpoint $< -40°$ F.
H. CO_2 'Lean' Amine
J. CO_2 'Rich' Amine
K. CO_2
L. Amine Condensate Return
M. Water of Combustion

Economical running

Occasionally, the presence of carbon dioxide may adversely affect work during heat treatment, but some means must be adopted to remove this compound. Scrubbing with mono-ethanolamine solution is generally used as this chemical possesses a strong affinity for carbon dioxide at normal temperatures but loses it again at boiling point. In the very compact plants developed by the Incandescent Heat Co. Ltd., the heat of combustion is used to reactivate the mono-ethanolamine, thereby allowing economical running and compactness of design. (Figs. 4 and 5.)

Ultra-high purity nitrogen can also be produced from fuel gas and air if extra purification stages are incorporated in the plant described above. A further requirement is for nitrogen-plus-hydrogen without any carbon monoxide, which has a tendency to 'crack,' giving soot and carbon dioxide at temperatures around 400°C. This is especially important where a very clean surface is required on steel. Plants capable of producing this mixture of gases are basically

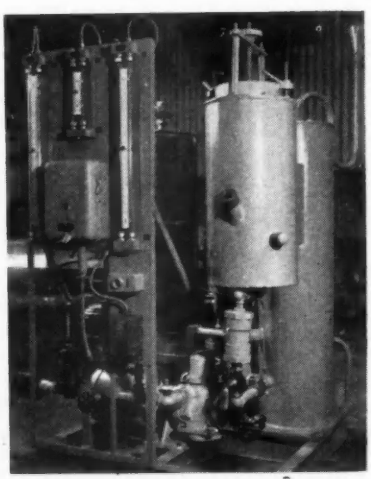


Fig. 3. An exothermic gas generator (250-300 cu.ft. per hour.).

the same as those already mentioned.

Fuel gas and air are burnt to nearly complete combustion, the product containing nitrogen, carbon dioxide, carbon monoxide, hydrogen and water vapour. Carbon monoxide is converted to carbon dioxide by reaction with steam in a 'shift' reaction. Carbon dioxide is then removed by scrubbing with monoethanolamine solution.

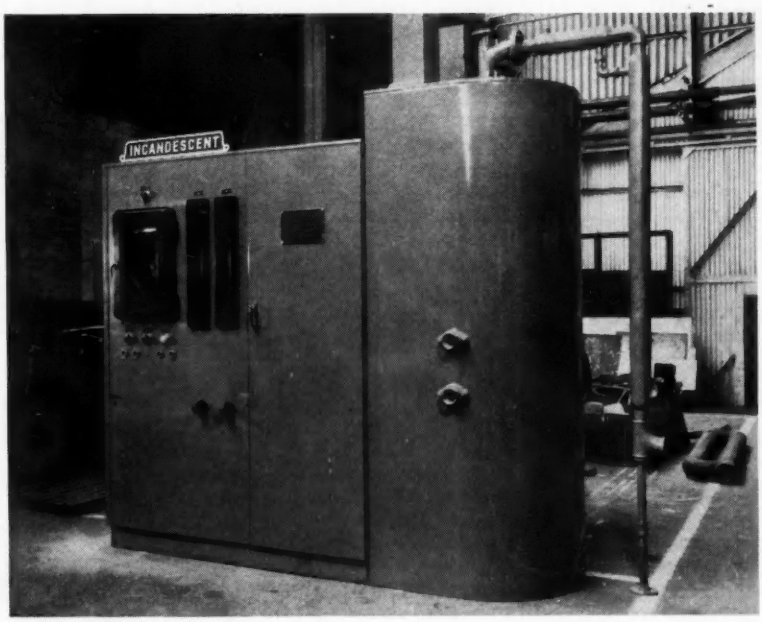
When air is reacted with a very large excess of fuel gas, insufficient heat is produced to maintain the reaction temperature. In consequence, external heating must be applied and the reaction is termed 'endothermic.' Normally a retort charged with catalyst selected to promote the complete breakdown of hydrocarbons is used, with external heating provided by gas or electricity. Hydrocarbons react with air to give a mixture of hydrogen, carbon monoxide and nitrogen. The amount of air used is just sufficient to supply oxygen for reaction with the total hydrocarbon content of the fuel gas. Whereas the air/gas ratio for propane is 7:1, that for town gas is generally in the order of 1:2½.

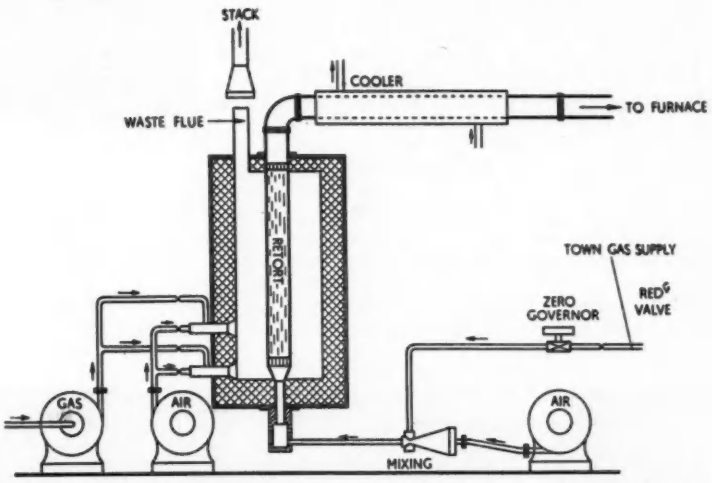
Preventing decarbonisation

Due to the external heating and to the formation of a carbon coating on the catalyst the product gas is virtually free of carbon dioxide and has a low dewpoint. Carbon leaves the reaction as carbon monoxide in association with hydrogen produced from water vapour.

This type of generator finds very wide use in a variety of metallurgical processes. In annealing or clean hardening high carbon steel, the presence of carbon monoxide prevents decarburisation.

Gas carburising requires an atmosphere which itself is neutral or mildly carburising to which a controlled addition of carbon rich gas such as propane may be made. The endothermic generator, because of the basic simplicity and relative freedom of pipework, is generally housed in a neat panel together with the various controls necessary for its operation. The illustrations (Figs. 6 and 7) show a schematic diagram and typical plant.





Figs. 6 and 7. An endothermic generator (1,000 cu.ft. per hour), with (below) a schematic diagram.

Town gas by itself and without processing has been used in a number of installations as a protective atmosphere during hardening; especially where the process time is short is work in shaker hearth furnaces frequently protected in this way. Generally, however, it is found that town gas varies too much to give consistent results, although this may sometimes be remedied by the addition of small amounts of ammonia.

Another possible use which is at present being investigated is sometimes in the preparation of hydrogen/nitrogen atmospheres from town gas. These atmospheres would be similar in composition to dissociated ammonia, but would cost much less to produce. This type of equipment should be of great interest to the many concerns engaged in metal sintering, especially where the usage rate is more than about 250 cu.ft. per hour.

The fields in which gaseous fuels play an important role are many, but their uses would be still further promoted if supplies of more uniform composition could be obtained and, in the case of town gas, if all sulphur compounds, including those with organic bases, were removed more completely than at present.

Kitchen installation

A complete kitchen has recently been installed at the new Herries Road bottling plant and offices of Duncan Gilmour & Co. Ltd., brewers and wine and spirit merchants, of Sheffield.

The whole of the kitchen and servery equipment was supplied and installed by Stotts of Oldham, including a 30-ft. long gas heated service counter, service being through hatches with beverage section between.

Furnace plant at the two factories of Babcock & Wilcox Ltd.

Continued from 'GAS IN INDUSTRY' January 6, 1960.

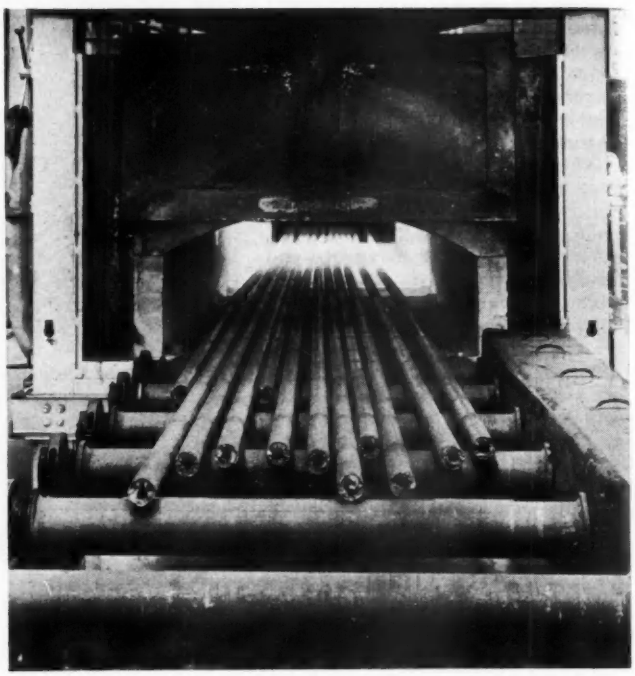


Fig. 10. Entrance to roller hearth annealing furnace.

TUBE from the reducing mill is subsequently cold drawn to its finished size, but before this, at successive stages of drawing and again on finishing, the tube is annealed. A Dowson & Mason continuous roller hearth furnace providing this treatmen is shown in Figs. 10 and 11. Tubes are heated to 950°C. and cooled to 500°C. before being discharged.

The diagram, Fig. 12, gives a general arrangement of the cross section. The total length inside the furnace is 88 ft. The first 20 ft. is the heating zone, the next 10 ft. the soaking zone, and the remaining 58 ft. the cooling zone. The width of the furnace inside is 4 ft., the effective loading width of the rollers being 3 ft. 10 in. Burners are arranged to fire both under and over the roller hearth from both sides and a flue is taken off at the charging end of the furnace. All rollers in the furnace and on the charge and discharge tables are driven through variable speed gears. In this way the tube is carried through the furnace at a speed which will ensure its proper treatment.

The whole of the heating and soaking sections, walls, roof and bottom, are constructed of 9 in. of lightweight insulating refractory backed by 3 in. of diatomaceous insulation.

Automatic proportioning air-blast tunnel burners using air at 28 in. w.g. are employed. In the first zone, the heating zone, there are six burners on each side, four firing under the rollers and two firing over the rollers. Each of these burners has a gas rate of

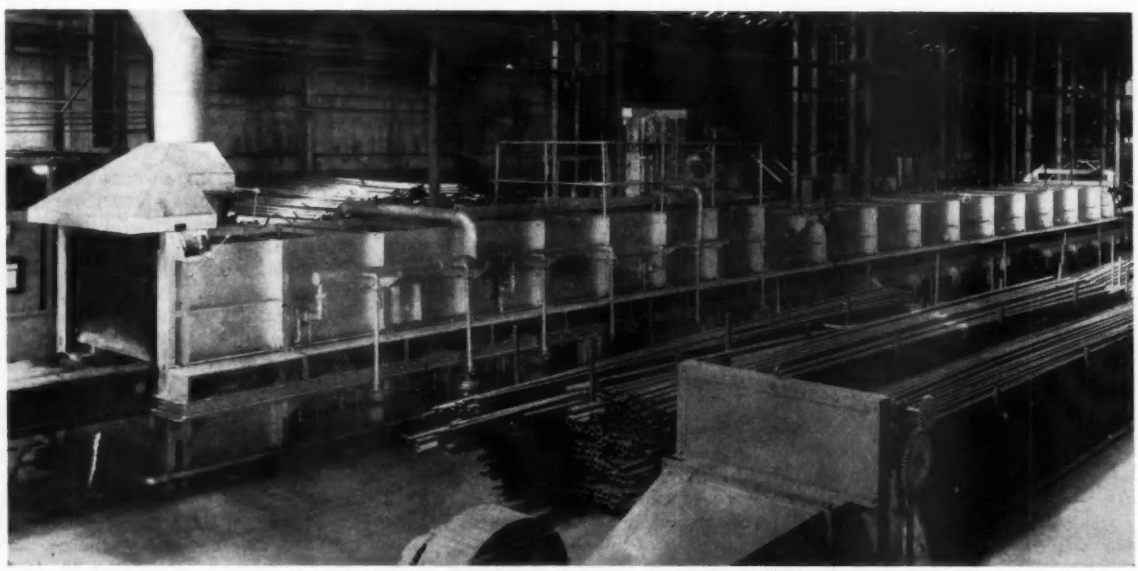


Fig. 11. Roller hearth annealing furnace.

2½ therms per hour. The soaking zone has three burners on each side, two below the rollers and one above, each only half the size of those in the heating zone. The total maximum gas rate of the furnace is 37½ therms per hour.

The rollers within the furnace consist of 5-in. dia. heat resisting steel tubes connected on the driven side by muff couplings to the driven stub shafts of mild steel rotating in split race roller bearings. The chain drive arrangement allows any roller to be removed while the others still rotate. All are fitted with seals to prevent leakage of hot gases or air infiltration. The rollers of the charge and discharge tables are of similar design, but use a mild steel roller tube.

Temperature control

The cooling zone is designed gradually to cool the tubes to a temperature lower than 500°C. before discharge. The side walls above the rollers, and the arch, are constructed of 4½-in. firebrick to dissipate the heat. A mild steel duct through which air for combustion is drawn is arranged behind the side walls. This assists the cooling and provides a small air preheat.

The heating and soaking zones each have Electroflo fully floating temperature control equipment with hydraulically operated furnace valves. In addition, six thermocouples are connected to a six-point recording pyrometer.

The furnace is designed to heat tubes to 950°C. and cool to 500°C. before discharge, tube sizes varying from 1½ in. o.d. to 3¼ in. o.d. and weight per foot from 2 lb. to 9½ lb., output two tons per hour. Some of the tubes are distorted when charged and a loading factor of 75% across the rollers has been allowed. The design loading was 10 3¼-in. dia. tubes or 23 1½-in. dia. tubes across the width of the furnace. The roller speed can be adjusted to give a linear speed of from 0.65 to 3.9 ft. per min.

Table IX

Steel	Temp., °C.	Throughput, *tons per hr.*	Gas consumption, *therms per hr.*	Gas consumption, *therms per ton*
Mild Steel	800	2	16·2	9·5
Alloy Steels	920	2·25	18	11
	935	1·75	18·5	12·5

Average performance figures for continuous operation throughout the week are given in Table IX.

The bogie hearth tube annealing furnace shown in Fig. 13 is designed for the heat treatment of alloy and mild steel tubes of maximum length 50 ft. at temperatures between 650°C. and 950°C., and is of similar design and construction to that in the tube and manifold department at Renfrew. It has, however, a door at each end and employs two full length bogies so that one may be loaded while the furnace is treating work on the other. The inside door width is 9 ft. 3 in. and the length 54 ft. The walls are of 9-in. insulating refractory backed up with 4½ in. of diatomaceous insulation. On the bogies there is 4½ in. of firebrick over layers of 4½ in. of insulating refractory and 4½ in. of diatomaceous insulation. As in other furnaces, the work is carried on cast stools, but because the furnace is frequently used in the higher temperature ranges, they are of heat resisting steel.

There are 80 burners, 40 at hearth level on each side, firing alternately horizontally and vertically, with a maximum rated capacity of 90 therms per hour.

For control purposes the furnace is divided into four zones, each zone being provided with Electroflo fully floating temperature control equipment, comprising an electronic recording and controlling potentiometer which operates air and gas proportioning valves through hydraulically operated regulators. The furnace is also provided with two six-point recording pyrometers connected to 12 thermocouples arranged at different positions in the furnace.

The waste gases from the furnace are taken away through an underground flue and the furnace pressure is controlled and recorded by Electroflo instruments. An electrical transmitting type recording and integrating ring balance flow meter is also provided.

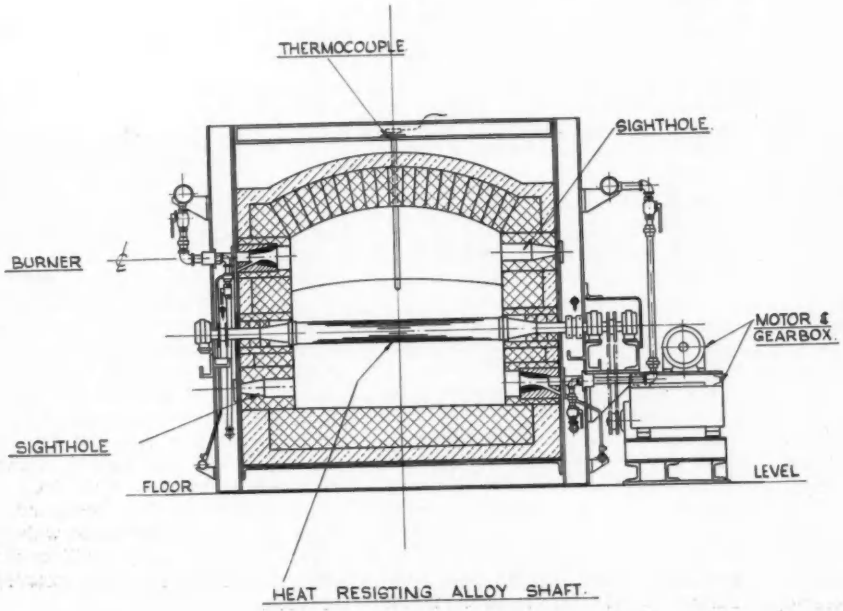
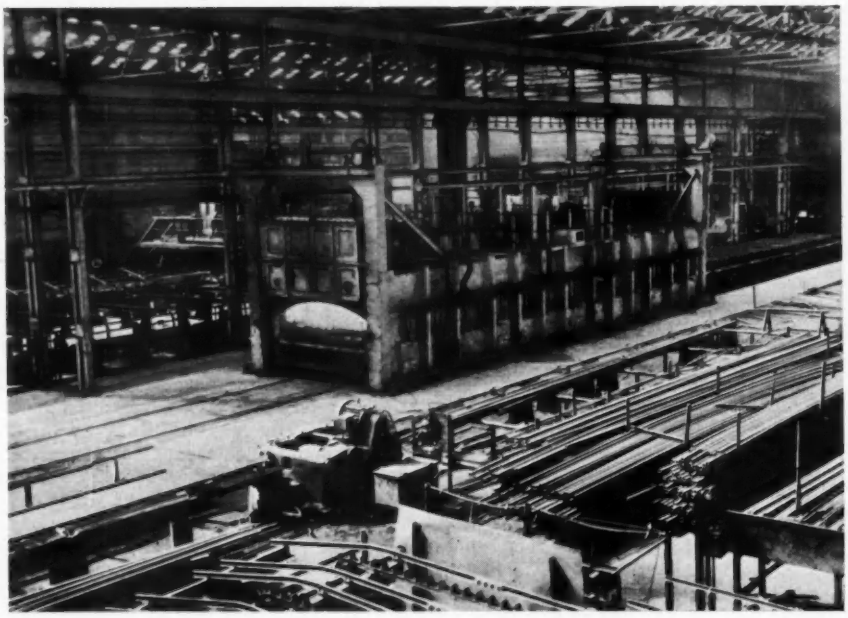


Fig. 12. Diagrammatic illustration of a roller hearth annealing furnace.



★

Fig. 13. A view from across the factory floor of a bogie hearth tube annealing furnace.

★

Table X

Operating temperature, °C.	Weight of charge, tons	Time to heat, hr. min.	Soaking time, min.	Gas consumption,	
				therms	therms per ton
800	9·93	4 0	30	333·9	33·6
850	10·89	4 15	30	387·3	35·6
900	9·63	4 35	30	381·3	39·6
920	10·63	4 55	30	430·8	40·5

A few production figures are given in Table X.

The plug and point which pierces the billet at the rotary elongator, and the pilger bar to which it is attached, both suffer very severe treatment. Cool bars are used for each billet, but nevertheless frequent reconditioning is necessary. The plugs weigh about 11 lb., and the bars range from 2 in. dia. by 6 ft. long to 4 in. dia. by 9 ft. 6 in. long and in reconditioning are heated to about 1,000°C. The furnace for this work, built by Dowson & Mason Ltd., has a hearth 5 ft. wide by 10 ft. 6 in. long and a height of 18 in. to the crown of the arch. Eight air-blast nozzle-mixing tunnel burners fire under the arch, four on each side. The maximum gas rate is 21½ therms per hour, using air at 6 in. w.g. The hot gases pass to the front of the furnace and through flues under the hearth to the main collecting flue at the back.

It is interesting, having seen the tremendous part played by gas in production at these factories, that this, the final installation to be described, shows gas helping also in maintaining the efficiency of the production plant itself.

EXTENSION TO BRAY RANGE OF ALL-METAL JETS

SINCE George Bray first succeeded in producing a ceramic-tipped gas lighting jet in 1863, the firm of Geo. Bray & Co. Ltd., which he founded, has supplied millions of scientifically designed jets to manufacturers of domestic and industrial appliances throughout the world.

The design of modern industrial appliances is tending to make the conditions under which the jets must operate more exacting. To meet this need Bray have designed a range of all-metal neat gas jets which give the same type of flame as the traditional style brass-socketed, ceramic-tipped Bray jet. They may be used at temperatures up to 800°C., and complement the ceramic-tipped range. However, their maximum consumption rate—13 cu. ft. per hour at 1½-in. w.g. —limits their use to certain domestic and smaller industrial appliances.

Bray have now extended their range of all-metal jets with a new large-consumption pattern in four different sizes to cover gas rates ranging from 40 to 70 cu. ft. per hour at 1½-in. w.g. pressure. These large-consumption jets also are capable of being used at temperatures up to 800°C. They are smaller and lighter than most other jets of similar consumption, having an overall height of about 1½-in. They have a ¼-in. B.S.P. male thread and can be screwed directly into a tapped burner rail without an intermediate boss, making their installation easy and cheap.

The wedge-shaped head ensures that the area of metal in contact with the flame is kept to a minimum, so reducing the downward heat conduction through the body to a much smaller figure than from a flame which rests on a large metal surface. Further cooling is provided by the fact that air for the flame is drawn upwards over the sides of the jet.

The robust one-piece construction of the No. 1200 jet, combined with its unique functional design, will ensure a long trouble-free life under exacting conditions.